



U.S. NUCLEAR REGULATORY COMMISSION

# STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

## 10.4.8 STEAM GENERATOR BLOWDOWN SYSTEM (PWR)

### REVIEW RESPONSIBILITIES

Primary - Chemical Engineering Branch (CMEB)

Secondary - None

### I. AREAS OF REVIEW

At the construction permit (CP) stage, CMEB reviews the steam generator blowdown system (SGBS), as described in the applicant's safety analysis report (SAR), in the specific areas that follow. At the operating license (OL) stage, the CMEB review consists of confirming the design accepted at the CP stage.

1. CMEB reviews the SGBS design basis in terms of its ability to remove particulate and dissolved impurities from the steam generator secondary side, thus assisting in maintaining optimum secondary-side water chemistry in steam generators during normal operation, including anticipated operational occurrences (main condenser inleakage and primary-to-secondary leakage). The design basis should include consideration of expected and design flows for all modes of operation (process and process bypass), process design parameters and equipment design capacities, expected and design temperatures for temperature sensitive treatment processes (demineralization and reverse osmosis) and process instrumentation and controls for maintaining operations within established parameter ranges.
2. Process sampling capabilities of the SGBS is reviewed by CMEB as part of its primary review responsibility for SRP Section 9.3.2.

CMEB will coordinate evaluations of other branches that interface with the overall review of the Steam Generator Blowdown System as follows: Mechanical Engineering Branch (MEB) reviews the system's seismic design and quality group classification as part of its primary review responsibility for SRP Sections 3.2.1 and 3.2.2, respectively; Structural Engineering Branch (SEB) determines the acceptability of the design analysis, procedures, and criteria used to establish the ability of seismic Category I structures housing the system and

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### USNRC STANDARD REVIEW PLAN

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

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supporting systems to withstand the effects of natural phenomena, such as the safe shutdown earthquake (SSE), the probable maximum flood (PMF), and tornado missiles as part of its primary review responsibility for SRP Sections 3.3.1, 3.3.2, 3.5.3, 3.7.1, 3.7.2, 3.7.3, 3.7.4, 3.8.4, and 3.8.5; the liquid and gaseous waste treatment aspects of the SGBS are reviewed in SRP Sections 11.2 and 11.3 and the liquid and gaseous process and effluent radiological monitoring is reviewed in SRP Section 11.5 by Effluent Treatment Systems Branch (ETSB) as part of its primary review responsibility for those sections; Auxiliary Systems Branch (ASB), as part of its primary review responsibility for SRP Section 3.6.1, evaluates the effect of high- and moderate-energy system piping failures to assure that safety-related equipment will not be made inoperable, evaluates the capabilities of the high energy portion of the SGBS to withstand the effects of internally generated missiles both outside containment in SRP Section 3.5.1.1 and inside containment in SRP Section 3.5.1.2; the Containment Systems Branch (CSB) determines that the blowdown lines penetrating the primary containment are isolated on a containment isolation signal and evaluates containment isolation dependability (NUREG-0737 Task II.E.4.2) as part of its primary review responsibility in SRP Section 6.2.4. The review of the quality assurance program is performed by the Quality Assurance Branch as part of its primary review responsibility for SRP Sections 17.1 and 17.2.

For those areas of review identified above as part of the primary review responsibility of other branches, the acceptance criteria necessary for the review and their methods of application are contained in the referenced SRP section of the corresponding primary branch.

## II. ACCEPTANCE CRITERIA

CMEB accepts the design of the steam generator blowdown system if the relevant requirements of General Design Criterion 1, 2, and 14 are met. The relevant requirements are as follows:

1. General Design Criterion 1, as it relates to system components being designed, fabricated, erected, and tested for quality standards.
2. General Design Criterion 2, as it relates to system components designed to seismic Category 1 requirements.
3. General Design Criterion 14, as it relates to secondary water chemistry control are complied with so that the primary coolant boundary material integrity will be maintained. The steam generator tubes are part of the reactor coolant pressure boundary, and these tubes could be degraded by adverse chemistry conditions on the secondary side. The SGBS primary function is to remove steam generator secondary side impurities and thus assist in maintaining acceptable secondary side water chemistry in the steam generators.

Specific Criteria necessary to meet the relevant requirements of GDC 1, 2, and 14 are as follows:

1. The SGBS is sized to accommodate the design blowdown flow needed to maintain secondary coolant chemistry for normal operation, including anticipated operational occurrences.

2. Equipment capacities are based on design blowdown flow rates and are such that temperature limits for heat-sensitive processes are not exceeded.
3. Instrumentation and automatic controls ensure operation within design parameters.
4. The design of the SGBS is seismic Category I and Quality Group B, from its connection to the steam generator inside primary containment up to and including the first isolation valve outside containment. The design of the SGBS downstream of the outer containment isolation valves is in accord with the provisions of Regulatory Guide 1.143, Position C.1.1.

### III. REVIEW PROCEDURES

The reviewer selects and emphasizes material from this SRP section as may be appropriate for a particular case.

1.
  - a. CMEB considers the pressure, temperature, flow rate, secondary coolant chemistry, main condenser water leakage, and primary-to-secondary leakage to determine whether the SGBS design has included the effects of normal operation and anticipated operational occurrences (e.g., main condenser inleakage or primary-to-secondary leakage). CMEB determines that the design parameters are reasonable. If the proposed system includes processes which are heat-sensitive (e.g., demineralization or reverse osmosis), CMEB verifies that the design includes instrumentation and controls to protect the temperature-sensitive elements. CMEB ensures that instrumentation and process controls are provided to control flashing, liquid levels, and process flow through the proper components for the radioactivity levels expected.
  - b. CMEB reviews the proposed piping and instrumentation diagrams (P&IDs) and process flow diagrams, the method of operation, the processing to be provided, and the interfaces between the blowdown system and other plant systems to determine: (1) whether unusual design conditions exist which could lead to safety problems, and (2) that the system is capable of performing its intended functions.
  - c. CMEB reviews the secondary coolant chemistry program for steam generator blowdown samples in SRP Section 5.4.2.1, BTP MTEB 5-3 (Monitoring of Secondary Side Water Chemistry in PWR Steam Generators).
  - d. CMEB coordinates its review with MEB to verify that the assigned classifications at the boundary interfaces between systems and/or system components are in accordance with the importance of the safety function to be performed and the guidelines of Regulatory Guides 1.26, 1.29, and 1.143.
2. SEB determines the seismic design and MEB determines the quality group and seismic design classification for the SGBS components as indicated above in subsection I, Areas of Review.
3. ETSB determines the capability to treat liquid and gaseous wastes associated with the SGBS as part of its review under SRP Sections 11.2 and 11.3.
4. ASB reviews the effect of SGBS high- and moderate-energy piping failures under SRP Section 3.6.1 to assure that other safety-related systems are not rendered inoperable.

#### IV. EVALUATION FINDINGS

CMEB verifies that sufficient information has been provided and that the review is adequate to support conclusions of the following type, to be included in the staff's safety evaluation report:

The steam generator blowdown system (SGBS) controls the concentration of chemical impurities and radioactive materials in the secondary coolant. The scope of review of the SGBS included piping and instrumentation diagrams, seismic and quality group classifications, design process parameters, and instrumentation and process controls. The review has included the applicant's evaluation of the proposed system operation and the applicant's estimate of the controlling process parameters.

The SGBS design meets the primary boundary material integrity requirements of General Design Criterion 14 as it relates to maintaining acceptable secondary water chemistry control during normal operation and anticipated operational occurrences by reducing corrosion of steam generator tubes and materials thereby reducing the likelihood and magnitude of primary-to-secondary coolant leakage.

The SGBS is seismic Category I and Quality Group B from its connection to the steam generator inside primary containment up to and including the first isolation valve outside containment in accordance with Regulatory Guides 1.26 and 1.29, because this portion of the SGBS is considered an extension of primary containment. The SGBS downstream of the outer containment isolation valves is not seismic Category I and meets the quality standards of Position C.1.1 of Regulatory Guide 1.143 since it is not safety related. Thus, the SGBS meets the quality standards requirements of General Design Criterion 1 and seismic requirements of General Design Criterion 2.

Based on the foregoing evaluation, we conclude that the proposed steam generator blowdown system is acceptable.

#### V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plan for using this SRP section.

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides.

#### VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 1, "Quality Standards and Records."
2. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

3. 10 CFR Part 50, Appendix A, General Design Criterion 14, "Reactor Coolant Pressure Boundary."
4. Regulatory Guide 1.26, "Quality Group Classifications for Water- Steam-, and Radioactive-Waste Containing Components of Nuclear Power Plants."
5. Regulatory Guide 1.29, "Seismic Design Classification."
6. Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components in Light-Water-Cooled Nuclear Reactor Power Plants."